10/584796

IAP11 Rec'd PCT/PTO 28 JUN 2006

METHOD FOR PRODUCING HEAT FOR HEATING BUILDING AND CONSTRUCTIONS AND A CONTINUOUS CAVITATION HEAT-GENERATOR.

TECHNICAL FIELD

The invention belongs to heat-power engineering, namely, to methods of getting heat, which originates differently than due to the fuel combustion and may be used for autonomous heating buildings and various purpose constructions, for heating water for industrial and domestic needs.

BACKGROUND OF INVENTION

1. Method for produsing heat for heating building and construction.

Methods of heating fluid are known, under which heat is got by means of the action of jet counter-current streams on the main fluid stream, or due to mechanical obstacles disposed on the way of the fluid, or by means of using of periodically working heat-generators with the limited volume of heat carrier, or decreasing volume of heat carrier at increasing power inputs for heating fluid or due to adding heavy water to the main stream.

The most similar method to the one, which is being claimed, is the method of heat getting by means of fluid heating devices – heat-generators described in patents RU 2045715 C1, F 25 B29/00, 10.10.1995, Bul.No.28 and UA 47535 C2, F 24J3/00, Bul. No.7.

Under this method, water of any purity (for example, technical water) with aid of the pump, which develops head pressure up to 0,6 MPa, is delivered to the input of the heat-generator, described in Patent RU 2045715 C1, F 25 B29/00 and due to this water with the total mass of 200 kg is heated in closed circuit with the initial temperature of 18-20° C up to the temperature of 70^0 C using 5,5 kilowatt output pump. Heat productivity of the heat-generator is not indicated in the patent, effectiveness is indicated without giving information on the outdoor air temperature, thickness, and material of premise walls heated by means of this device and this method, and the rate of periodical fluid heating in closed circuit is indicated, the discrepancy being 1.5° C per minute.

In the method of heat getting by means of the same device indicated in patent UA 47535 C2, F 24J3/00, 15.07.2002, Bul. No.7, the problem is set concerning the method of getting heat by changing and refining of water temperature interval used for heat getting in the heat-generator and providing of heat production effectiveness increase.

The set problem was being settled by illustrating the examples given, under which preliminary heating of water up to the temperature of 63-70° C was carried out by the instrumentality of an electric heating unit or a heat-generator with the same performance data. Then, the operating circuit of a similar heat-generator was filled with that heated water and after its performance in the closed cycle, the heating temperature of 0.8° C per minute was acquired, up to the water boiling point. In the other example given, electromotor capacity is increased up to 11 kilowatt, i.e. two times as much and the operating circuit of the heat-generator is filled with water of the same mass of 100 kg with the temperature above 63° C. At that, as it is stated in Patent UA 47535 C2, 15.07.2002, Bul. No.7 heat-generator operation effectiveness leveled 2.

Thus, the problem posed in patent is undoubtedly proved in its first part, i.e. that the intensity of water heating increases at the temperature above 63° C and lasts up to the boiling point, but in the other part of the posed problem, actual calculations of the heat production effectiveness were being made without taking into account preliminary power inputs for heating water to the temperature above 63° C.

When using a more powerful pump and decreasing mass of water twice, relative to previous Patent UA 47535 C2, 15.07.2002, Bul. No.7 the device effectiveness increased. Thus, it is confirmed that operating fluid heating intensity in a closed circuit depends foremost on the increasing of the stream circulation velocity in the device per time unit, i.e. on the intensification of cavitational and shock-wave processes.

The disadvantages of the currently in use method are insufficient heat generation effectiveness provided increasing of the operating fluid volume without increasing of the pump output and frequent periodicity of heat carrier (water) delivery to a premise hot-water heating system with operating the temperature of 70° C, where it gives away a part of its heat and returns to the heat-generator inlet with the temperature of 65-67° C and consequently reduces to frequent activations of the pump, i.e. to excessive power inputs, to the delivery pump wear-out, and to the impossibility of keeping of the heat carrier temperature in the heating system for quite long, and also to the impossibility of using of the method and the device in technological operations requiring superheated water temperature.

2. Fluid heating devices are known, which comprise a heat-generator with an operating fluid input and output, a pump connected to the heat-generator inlet, a stream accelerator, and a tubular part with a brake arrangement at the heat-generator outlet, to which a return pipe is connected.

(UA 7205 A, F 25 B29/00, 30.06.1995, Bul. No.2; RU 2045715 C1, F 25 B29/00, 10.10.1995, Bul. No.28; UA 22003 A, 30.04.1998, Bul. No.2).

The principle of operation of currently in use devices is based on using of operating fluid pressure differential and on using cavitational processes originating in the fluid stream and resulting in increasing of its temperature.

The most similar analog of the utility invention is the device for fluid heating comprising a heat-generator with an operating fluid input and output, a pump connected to the heat-generator input, a stream accelerator, feeding and return pipes, a tubular part with a brake arrangement at the heat-generator outlet, to which the return pipe is connected, injection pipes, sequence unidirectional egg-shaped pipes, cylindrically ported bushings with cylinder passages, a conical fluid splitter. (UA 22003 A, F 25 B29/00, 30.04.1998, Bul. No.2)

The disadvantages of the currently in use method are insufficient heat generation effectiveness on condition of increasing of the operating fluid volume, low rate of thermodiffusion process occurring in the operating fluid thus limiting the device performance capabilities.

DISCLOSURE OF INVENTION

The basis of the invention is the problem concerning the method of heat getting that provides increasing of heat effectiveness getting, provided, the heat carrier total mass increases without power inputs increasing, and the method by the instrumentality of which the simultaneous heat carrier delivery to consumers and its heating by the instrumentality of the one heat-generator are possible.

The problem posed is settled by means of delivering ethylene glycol (ethandiol) $HOCH_2 - CH_2OH$ at the amount up to 7% in solution, its boiling point being 114° C under normal conditions, into water in a closed tank for the heat carrier (36). The heat carrier total volume in the tank (36) involves the volume necessary for filling of the heating system and heat exchangers (44), and additional water volume amounts to 0.7 of the heating system volume and indicated in Fig.9 with dotted line – the first water level.

In addition to the possibility of operating fluid boiling temperature increasing, the presence of ethylene glycol in water conduces the continuity of the air-to-water phase provided stream velocity increasing up to supersonic, for the given medium, in the slotted space of the accelerator-promoter and heat-generator, and provides the more continuous

nonfreezing state of the heating system in case of breakdown circumstances and the heat-generator turning off.

The achievement of the goal of the method of the heat getting effectiveness increase occurs by means of using of a complementary device, it being a tube made of stainless steel (39), the upper end of which goes to the air hood space of the heat carrier tank (36), and the lower end is submerged into the intake manifold (34) of the pump (35) and possesses vertical holes in its lower part (53) distributed uniformly along the tube perimeter, but they do not exceed in height the intake manifold limits (34) of the pump (35). The availability of this device provides the possibility, by means of pumping-in a corresponding amount of air together with the operating fluid stream into the heat-generator system, to intensify the heat exchange due to fluid stream saturation with incipient cavitational air-beads and partial water pressure decrease, that, in its turn, influences the heat transfer rate, which under such conditions increases up to 20% in the heat-generator, and allows extra raising of the operating fluid boiling-point by 5% - up to 120° C.

Thus, the posed problem of the heat getting method is settled, that provides its getting effectiveness increase and the raise of the operating fluid boiling point without atmospheric pressure changing.

The second part of the posed problem provides the method due to which the simultaneous heat carrier delivery to the consumers and its heating by the instrumentality of the same heat-generator are possible.

The posed problem is settled due to the fact that the operating fluid tank (36) has a layer of material with a low heat conductivity specific coefficient corresponding to the necessary calculation, and allows holding the heated heat carrier temperature without considerable reduction of its temperature for long. The operating fluid tank (36) is embodied in the following way, it has two sections with a baffle (37) made of heat transfer low coefficient material, and interconnected by a pass for the operating fluid (38) in the lower part, and also are connected by a baffle (37) in the tank air hood space (36) that makes it possible to equalize pressure balance in the tank sections and to maintain an equal level of the operating fluid in the tank. The presence of two sections makes it possible to heat more actively the operating fluid in which the heat-generator is disposed and to prevent the continuous process of thermodiffusion for large mass of the heat carrier. In the other part, the operating fluid with lower temperature is placed, which is offtaken by the intake manifold (34) of the pump (35) together with air in ratio 0,002 of the volume of the offtaken operating fluid mass, which passes through the intake manifold of the pump

delivering water to the heat-generator from the pass (38). The heat-generator (10) and the operating fluid tank (36) are jointed with the heating system (or hot water delivery system) by means of a discharge connection (21) and return pipe (45), which enters the tank air hood space zone of the operating fluid through a flange, but does not touch the fluid's surface. The tank is also equipped with a thermocouple (40) for taking a reading of the operating fluid temperature, and for checking and steering through a control-regulating device assemblage (49) by a normally closed electrohydrovalve (41). The operating fluid tank (36) is additionally equipped with a tap (51) for the system replenishment with the operating fluid if necessary, or it can be used for connecting to the water-supply system with the purpose of continuous water delivery to the tank. For the operating fluid discharge from the tank, a tap (52) is provided, which is disposed in the lower part of the tank. With the purpose of the system independence from the centralized mains and for an emergency turning off, a diesel-generator set (54) of a necessary capacity is provided, which is connected to the pump and the control-regulating device assemblage (49). The system is also equipped with the manually operated faucets for the system change to the operating mode (42) and manual discharge of the operating fluid from the heating system and heat exchangers (44). To prevent a hydraulic shock in the pipe system, the tank for hydraulic shock damping is provided (43), which is placed after the taps (41, 42). The return pipe is equipped with a thermocouple (46) connected to the control-regulating device assemblage (49) and making it possible to take temperature readings in the return pipe and to manage the normally closed electrohydrovalve operation (47) by the control-regulating device assemblage. The control-regulating device assemblage (49) operates all the system modules in the automatic mode.

As the basis of the invention, the problem of refinement of the heating fluid device is also posed, in which changing of its construction and supplementing of it with new accessories provide the production of large amount of heat energy, intensification of the thermodiffusion process and continuity of the cavitational heat-generator operation for the heating operating fluid of considerable volume and its simultaneous delivery to the feeding pipe.

The posed problem is settled due to the fact that the continuous working cavitation heat-generator with the operating fluid inlet and outlet, the pump, feeding and return pipe, in accordance with the invention, additionally comprises an operating fluid accelerator-promoter (Fig.2), which is connected to the pump (35) and to an adapter sleeve for fluid delivery (33), which comprises at least three successively connected manifolds with passes

of different diameters, which are interconnected with flanges of the main fluid stream direction change (27), with conical cant and ejection accelerating passage (29) disposed tangentially to the manifold pass (26). The operating fluid accelerator-promoter is additionally equipped with static cavitators (24,31) with radially disposed holes, which generate stream of calibrated cavitational bubbles, which enter the stream slotted zone with the purpose of decomposition of cavitational bubbles and creation of their secondary stream. The operating fluid accelerator-promoter is additionally equipped with a slotted ejector (23) and with a chamber of the operating stream increased pressure (1), which possesses a slotted ejection accelerating passage disposed tangentially to the pass of the central manifold (2) of the heat-generator (Fig.1). The central manifold (2) of the heat-generator is connected to its central part (7) which comprises a static cavitator (3) with radially disposed holes (4) generating a stream of calibrated cavitational bubbles, and possesses radial passages (5) in the slotted stream zone. The static cavitator (3) also comprises a cavitating Laval nozzle (6), that provides instantaneous narrowing and widening of the main fluid stream and conduces the formation of a secondary stream of decomposed cavitational bubbles.

The continuously working cavitational heat-generator additionally comprises separating flanges (10, 11) of the main fluid stream with a conical splitter, which under pressure uniformly distributes the operating fluid through slotted tangentially directed passages (12, 23) into the outlet fitting passages (14) of the heat-generator, disposed concentrically against the central manifold (2) of the heat-generator, which are at least five, and a feeding pipe (21) of the heating system, or hot water delivery to consumers. The outlet fittings (14) are equipped with static cavitators (15) with radially disposed holes (16), which generate stream of calibrated cavitational bubbles, annular channels (17) in the fitting body (19) and cavitating Laval nozzles (18), which decompose cavitational bubbles. The outlet fittings (19) are additionally equipped with nozzle outlets (20) of the heat-generator, their angle of inclination being 45° to the fitting axis and directed sideways from the central manifold (2) of the heat-generator.

BRIEF DESCRIPTION OF DRAWINGS

On the drawings a schematic sketch of the continuous cavitation heat-generator and its units is presented, and also a diagram (Fig.9), which illustrating realization of the claimed method in accordance with the invention.

BEST MODE OF CARRYING OUT THE INVENTION

1. The system embodying the method of the simultaneous heat carrier delivery to consumers, and its heating by the instrumentality of the same heat-generator runs as follows.

After filling the tank with the operating fluid (36) in the amount necessary, as it has been mentioned before, with its initial temperature above 5° C, the pump (35) is turned on without participation of the control-regulating device assemblage (49), and the heating operational fluid occurs by the instrumentality of the heat-generator up to the temperature of 90° C, a thermocouple (40) controlling the heating process. After the operating fluid reached the temperature of 90° C, a manual control valve (42) smoothly opens and the operating fluid enters the heating circuit with heat exchangers (44) the heat-generator being turned on, and at the same time the faucets (48, 51) are to be opened. The thermocouple (46) takes readings of the heat-generator in the return pipe (45). After filling the heating system with the operating fluid, the valves (42, 48, 51) are got closed, the pump is turned off and the heat carrier operating temperature is displayed on the control-regulating devices in the feeding and the return pipes of the heating system. The upper temperature of closing of the electrohydrovalve (41) is set, it being lower than the operating fluid temperature of 90° C in the tank (36), for example, 80° C, and that of the simultaneous turning off of the pump (35), the temperature of the opening of the electrohydrovalve (47) is set, for example, 60° C, and that of the automatic turning on of the pump (35) for starting heat-generator operation. The temperature of 90° C is also set for the opening of the electrohydrovalve (41). After this, the pump and the heat-generator start automatically. When the operating fluid temperature in the tank levels 90° C, the valves gets opened (41) and (47) and the heat-generator pressurizes water into the system, and at the same time, it continues to heat the operating fluid in the tank. When the temperature in the return pipe levels 80° C, the valves (41, 47) close automatically, the pump is turned off until the cooling of the system levels 60° C, whereupon the valve (47) is opened and the pump automatically starts and the heat-generator starts, which delivers water into the system through the open valve (41) after its proper heating. The time necessary to level the temperature of the heating required will be petty, due to the fact that the water mass entering at the temperature of 60° C from the return pipe (45) is petty if compared with the water mass, which is in the tank and is of the temperature not lower than 80° C, consequently it will be heated to the temperature higher

than 63° C, at which, as proved in Patent UA 47535 C2, F24J3/00, abrupt intensification of the operating fluid heating rate occurs. After heating of the operating fluid in the tank up to the temperature of 90° C, the system enters an automatic operation mode and the whole cycle is repeated in the same order, and at the same time the heat-generator operation time will depend on the set temperature parameters of the heating system, and turning on frequency of the heat-generator will automatically depend on the environment temperature, which influences the temperature condition of the premise heated.

Hereby, the method of the simultaneous heat carrier delivery to consumers and its heating by the instrumentality of the one heat-generator is carried out.

Changing of the pump capacity parameters, increasing or decreasing of the total volume for the operating fluid tank and the ratio of its parts, which are variable quantities, and also a successive connection of heat-generators systems in accordance with the stated method is evident for the specialists in this field and can not be the reason for improving the method, concerning the given invention.

2. The continuous cavitation heat-generator together with the described devices runs as follows.

The fluid (water) stream by the instrumentality of the pump (35) enters the manifold pass (32) of the accelerator-promoter (Fig. 2) at the velocity of 7 m/sec, then it goes to the conical part of the static cavitator (31), where it is swirled and gains the velocity of 9 m/sec. At such velocity, the fluid stream enters the inner passage of the static cavitator (31) its diameter being 2.4 times less than the manifold pass (32), and at the same time the fluid stream velocity increases up to 14 m/sec. The inner passage of the static cavitator is no-go, consequently, reaching its conical end, the main stream is additionally swirled and gets return motion, and at the same time due to the turbulization and heat generation due to the transformation of the stream kinetic energy into heat energy, the primary process of cavitational bubbles origination occurs. Further, in two rows of radial holes, which are the generators of the uniform stream of calibrated cavitational bubbles of the same size, the main stream abruptly changes its motion direction, and at the same time heat energy is released additionally entering the stream slotted zone at the velocity of 24 m/sec and goes to the manifold radial passages (30), where the active process of cavitational bubbles collapse occurs with the energy release and local increase of the cumulative streams velocity up to 700 m/sec, and also primary bubbles decomposition in their saturated stream with lesser diameter up to 20-25 • 10^{-6} m. At the same time, in the slotted gap formed by

the outer diameter of the static cavitator (31) – d_C, and the manifold inner diameter (30) – D, the coefficient of the stream compression is determined in accordance with the formula:

$$V_{IN} \bullet D^2 = V \bullet (D^2 - d^2_C),$$

Whence

$$\frac{d_C}{D} = \sqrt{1 - \frac{V_{IN}}{V}} = \sqrt{1 - \frac{7}{24}} = 0{,}84,$$

where: V_{IN} – initial fluid stream velocity imposed by the pump;

V - fluid stream velocity received by it at the entry into the slotted gap;

$\frac{d_c}{D}$ – coefficient of continuity (compression) of the air-to-water mixture stream.

Air-to-water mass of beads originates, which is compressible (as opposed to fluid), with the volume air contents of 0.8 that results in originating of additional shock waves and supersonic flow. Sonic speed for the air-to-water mass is figured in accordance with the Wood formula:

$$a \simeq \sqrt{\frac{P}{\alpha \circ (1 - \alpha) \circ \rho_f}}$$

where: P – pressure in air-to-water mixture

α – volume air contents;

ρ_f — fluid volume thickness.

Thus, $\alpha = 0{,}8$; $\alpha \circ (1 - \alpha) = 0{,}16$, and the sonic rate for the given medium amounts to 25 m/sec.

For the further activation of the heat buildup process by means of the origin of shock waves of supersonic and shock cavitation, at closing of bubbles with the diameter of 20-25 mkm during their collapse, a supersonic stream velocity is needed to form the air-to-water mixture, that can be achieved in the slotted gap and in the cavitating Laval nozzle, which is disposed on the end of the static cavitator (31), that provides instantaneous narrowing and widening of the main fluid stream. Further the main fluid stream enters the running part of the increased pressure passage of the manifold (30) where a complete spot

collapse of microbubbles occurs without formation of cumulative streams and, consequently, the fluid is heated intensively.

Further the main fluid stream enters the manifold conical passage (28), where its velocity again increases up to 5 m/sec and in the manifold cylindrical pass (28) of the diameter equaling 0,5 of that of the manifold pass (32), where its velocity increases up to 9 m/sec and an abrupt stream motion direction change occurs due to the guiding conical slant of the flange (27) in the ejection accelerating passage (29), which is disposed tangentially to the manifold pass (26), and at the same time the main fluid stream velocity increases up to 14 m/sec. When passing the manifold passage, the stream is swirled and this results in the heat energy release. Further, the main fluid stream enters the manifold conical passage (25), where it again acquires the velocity of 9 m/sec and enters the inner passage of the static cavitator (24), where the same physical phenomena occur, as when the stream passing the static cavitator (31) with heat energy release. Further, when passing the manifold (28), the flange of the stream motion direction change and passages (25, 26) and the static cavitator (24) of the manifold (22), successive increasing of the main fluid stream temperature occurs.

At the accelerator-promoter outlet (Fig.2), a slotted ejector (23) with holes is installed, when passing through them, the main stream acquires acceleration and cavitational bubbles are being formed, which collapse in the higher pressure chamber (1) and heat energy is released. Through the slotted ejection acceleration passage disposed tangentially to the manifold pass (2), the main fluid stream enters the pass (2) of the heat-generator central manifold at the velocity of 9m/sec, then it is swirled and heat energy is released. When passing the static cavitator (3), and generating bubbles holes, radial passages (5) and Laval nozzles (6), heat energy is also released and the stream enters the manifold conical passage (8), where it is swirled and heat energy is released again. When the main fluid stream enters the distributing flange (10) with the conical splitter, the main stream is divided into streams, which enter the slotted tangentially directed passages (12, 13) and into running passages of the outlet fittings (14), which are at least five, and also into the running passage of the feeding pipe (21) of the heating system, or hot water delivery to consumers and acquires the velocity of 8 m/sec.

The disposition of the slotted passages entering (12, 13) relative to the manifolds (14, 21) is shown on (Fig.4, 5) for the northern and southern hemispheres, which is connected with the influence of the terrestrial magnetic field on water, which is diamagnetic and has magnetic susceptibility $\chi = - 13,0 \cdot 10^6$ at spiral motion of the main

fluid stream, which is of the same direction as the action of the terrestrial magnetic field strength vector in different hemispheres, with the purpose of increasing of the velocity of the main stream. Besides, the fluid stream, which is swirled in the outlet fittings (14), will be influenced by Coriolis force, which will divert the external fluid layers in the direction perpendicular to its relative velocity and exert pressure upon the manifold pass walls (14), which will result in heat energy release.

The slotted passage cross-section area (13) depends on the heat carrier volume, which is to be delivered to the feeding pipe (21) and is a variable quantity, due to which it regulates the heat carrier delivery rate.

After this, the fluid stream enters the inner running passages of the static cavitators (15), passes through the radial passages (16), the slotted stream zone with annular channels (17) in the manifold body (19) and cavitational Laval nozzles (18), and at the same time the same physical processes and heat energy release occur, as when passing the fluid stream through the accelerator-promoter of static cavitators (Fig.2) and the heat-generator central manifold (2). When passing the fluid stream through the nozzle outlets (20) of the manifolds (19), which have angle of inclination 45 to the manifold axis, additional heat energy is released and the total area of thermodiffusion process is increased 5 times more (as a minimum), if compared with the construction of heat-generators with one operating fluid nozzle outlet.

Thus, the posed problem of refining the device by means of the construction change and its supplement with new devices provides that the cavitational generator produces large amount of heat energy for heating considerable volume of fluid and continuity of its action with simultaneous delivery of the fluid to the feeding pipe.

Changing of the quantity of the accelerator-promoter elements and the quantity of the operating fluid outlet fittings, which are disposed concentrically relative to the heat-generator central manifold or changing of the cross-section area of the feeding pipe passage is evident for the specialists in this field and cannot be the ground for refining the device, relative to the invention.

INDUSTRIAL APPLICABILITY

The continuously working cavitational heat-generator and the claimed method of getting heat, in accordance with this invention, can be used for autonomous heating of buildings and different purposes constructions, in agriculture, in technological operating processes or for energy generating.